National Imaging Associates, Inc.*	
Clinical guidelines **NECK MRA/MRV**	**Original Date: September 1997**
CPT Codes: 70547, 70548, 70549	**Last Revised Date: ~~April~~ March 2022~~1~~**
Guideline Number: NIA_CG_012-2	**Implementation Date: January 2023~~2~~**

INDICATIONS FOR NECK MRA

If there is a combination request* for an overlapping body part, either requested at the same time or sequentially (within the past 3 months) the results of the prior study should be:

- **Inconclusive or show a need for additional or follow up imaging evaluation OR**
- **The office notes should clearly document an indication why overlapping imaging is needed and how it will change management for the patient.**

(*Unless approvable in the combination section as noted in the guidelines)

For evaluation of known or suspected extracranial vascular disease

Cerebrovascular Disease

- Recent ischemic stroke or transient ischemic attack[1-3] ~~(Robertson, 2020; Salmela, 2017; Sanelli, 2014)~~
- Known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as dizziness, vertigo, headaches, diplopia, blindness, vomiting, ataxia, weakness in both sides of the body, or abnormal speech[4-6] ~~(Lima Neto, 2017; Searls, 2012; Yang, 2005)~~
- Asymptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g., carotid stenosis ≥ 70%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries)[7-9] ~~(Brott, 2011; DaCosta, 2019; Marquardt, 2010)~~
- Symptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g., carotid stenosis ≥ 50%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries)[7, 10, 11] ~~(Brott, 2011; Chaturvedi, 2005; Rerkasem, 2011)~~

Aneurysm screening

- Screening for aneurysm in Loeys-Dietz syndrome**, fibromuscular dysplasia or spontaneous coronary arteries dissection (SCAD)[12-15] ~~(Hayes, 2018; Hitchock, 2014; Macaya, 2019; MacCarrick, 2014)~~

  ** For Loeys-Dietz imaging should be repeated at least every two years

Tumor/pulsatile mass

* National Imaging Associates, Inc. (NIA) is a subsidiary of Magellan Healthcare, Inc.

- Pulsatile mass on exam[16] ~~(Aulino, 2019)~~
- Known carotid body tumors, or other masses such as a paraganglioma, arteriovenous fistula, pseudoaneurysm, atypical lymphovascular malformation[17, 18] ~~(Al-Rawaq, 2018; Nguyen, 2011)~~
  Note: Ultrasound (US) may be used to identify a mass overlying or next to an artery in initial work up of a pulsatile mass.

Other extracranial vascular disease

- ~~Takayasu arteritis based on imaging findings in in other blood vessels on previousother vasculature imaging[19] (Zhu, 2012)~~
  ~~Giant cell arteritis with suspected extracranial involvement[20-23] (Abdel Razek, 2014; Halbach, 2018; Khan, 2015; Koster, 2018)~~
- **Large vessel vasculitis (Giant cell or Takayasu arteritis) with suspected extracranial involvement**[19-23]
- Subclavian steal syndrome when ultrasound is positive or indeterminate OR for planning an intervention[24] ~~(Potter, 2014)~~
- Suspected carotid or vertebral artery dissection; ~~due~~ **secondary** to trauma or spontaneous due to weakness of vessel wall[25, 26] ~~(Franz, 2012; Shakir, 2016)~~
- Horner's syndrome (miosis, ptosis, and anhidrosis)[27] ~~(Kim, 2012)~~
- For evaluation of pulsatile tinnitus (subjective or objective) for **suspected arterial** vascular etiology[28] ~~(Pegge, 2017)~~
- **For further evaluation of a congenital vascular malformation of the head and neck**
-
- Known extracranial vascular disease that needs follow-up or further evaluation[29-31]

Pre-operative/procedural evaluation

- Pre-operative evaluation for a planned surgery or procedure

Post-operative/procedural evaluation (e.g., carotid endarterectomy)

- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

INDICATIONS FOR COMBINATION STUDIES

Neck MRA/Brain MRA

- Recent ischemic stroke or transient ischemic attack (TIA)[1, 2, 32] ~~(Robertson, 2020; Salmela, 2017; Wintermark, 2013)~~
- Known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as dizziness, vertigo, headaches, diplopia, blindness, vomiting, ataxia, weakness in both sides of the body, or abnormal speech[4, 5] ~~(Lima Neto, 2017; Searls, 2012)~~
- Suspected carotid or vertebral artery dissection ~~due~~ **secondary** to trauma or spontaneous due to weakness of vessel wall[25, 26] ~~(Franz, 2012; Shakir, 2016)~~

- Asymptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g., internal carotid stenosis > 70%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate[7-9] ~~(Brott, 2011; DaCosta, 2019; Marquardt, 2010)~~
- Symptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g., carotid stenosis ≥ 50%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate[7, 8, 10] ~~(Brott, 2011; DaCosta, 2019; Rerkasem, 2011)~~
- For evaluation of pulsatile tinnitus (subjective or objective) for **suspected arterial** vascular etiology[28] ~~(Pegge, 2017)~~

Neck MRA/Brain MRA/Brain MRI

- Recent ischemic stroke or transient ischemic attack
- Suspected carotid or vertebral artery dissection with focal or lateralizing neurological deficits
-
- Approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent vascular and intracranial pathology[33] ~~(Lawson, 2000).~~

Any Combination of Neck MRA/Brain MRA/Brain MRI with IAC

- **Pulsatile tinnitus with concern for a suspected arterial vascular and/or intracranial etiology**[28, 34]

~~Pulsatile tinnitus with concern for a suspected arterial vascular and/or intracranial etiology~~[29, 35~~12~~]

BACKGROUND

For vascular disease, in general, MRA and CTA are comparable. No current literature compares the efficacy of contrast enhanced CT to CTA or MRI and MRA for evaluation of pulsatile neck mass, so any are approvable. MRA may be complementary to MRI in the following settings: evaluation of a pulsatile neck mass to assess vascular detail when needed; assessment of relevant vascular anatomy for pre-procedural evaluation; vascular supply to tumors and vessel encasement and narrowing by tumors; extent of disease in vasculitis; and to help determine the nature and extent of congenital or acquired vascular anomalies ~~(Ansari, 2020)~~.[35]

MRA vs CTA for Carotid Artery Evaluation[36, 37] **– ~~Disease~~**

MRA and CTA are generally comparable noninvasive imaging alternatives, each with their own advantages and disadvantages. MRA is an excellent screening test since it does not utilize ionizing radiation. Duplex US and contrast-MRA is a common choice for carotid artery evaluation. Limitations of MRA include difficulty in patients with claustrophobia and the risk

of nephrogenic systemic sclerosis with gadolinium contrast agents in specific patients. Advantages of CTA over MRA include superior spatial resolution, rapid image acquisition, decreased susceptibility to motion artifacts and artifacts from calcification as well as being better able to evaluate slow flow and tandem lesions. However, it can also overestimate ~~of~~ high-grade stenosis. Limitations of CTA include radiation exposure to the patient, necessity of IV contrast, and risk of contrast allergy and contrast nephropathy.

MRA and Carotid Body Tumor – Carotid body tumors are found in the upper neck at the branching of the carotid artery. Although most of them are benign, they may be locally aggressive with a small malignant potential. MRA may be used to identify a carotid body tumor due to its ability to define the extension of the tumor in relation to the carotid arteries, involvement of the base of the skull and bilateral tumors.

MRA and dissection ~~–~~ Craniocervical dissections can be spontaneous or traumatic. Patients with blunt head or neck trauma who meet Denver Screening criteria should be assessed for cerebrovascular injury (although about 20% will not meet criteria). The criteria include: focal or lateralizing neurological deficits (not explained by head CT), infarct on head CT, face, basilar skull, or cervical spine fractures, cervical hematomas that are not expanding, glasgow coma score less than 8 without CT findings, massive epistaxis, cervical bruit or thrill ~~(Franz, 2012; Liang, 2013; Mundinger, 2013; Simon, 2019)~~.[25, 38-40] Spontaneous dissection presents with headache, neck pain with neurological signs or symptoms.

There is often minor trauma or precipitating factor (e.g., exercise, neck manipulation). Dissection is thought to occur due to weakness of the vessel wall, and there may be an underlying connective tissue disorder. Dissection of the extracranial vessels can extend intracranially and/or lead to thrombus, which can migrate into the intracranial circulation causing ischemia. Therefore, MRA of the head and neck is warranted ~~(Nash, 2019; Shakir, 2016)~~.[26, 41]

Post-operative evaluation of carotid endarterectomy – Carotid endarterectomy is a vascular surgical procedure that removes plaque from the carotid artery. MRA with multiprojection volume reconstruction is a non-invasive imaging modality that is an alternative to postoperative angiography following carotid endarterectomy. It allows the surgeon to get informative and comparative data.

MRA and recent stroke or transient ischemic attack (TIA) ~~–~~ A stroke or central nervous system infarction is defined as "brain, spinal cord, or retinal cell death attributable to ischemia, based on neuropathological, neuroimaging, and/or clinical evidence of permanent injury. … Ischemic stroke specifically refers to central nervous system infarction accompanied by overt symptoms, whereas silent infarction causes no known symptoms ~~(Sacco, 2013)~~."[42] If imaging or pathology is not available, a clinical stroke is diagnosed by symptoms persisting for more than 24 hours.

Ischemic stroke can be further classified by the type and location of ischemia and the presumed etiology of the brain injury. These include large-artery atherosclerotic occlusion (extracranial or intracranial), cardiac embolism, small-vessel disease and less commonly dissection, hypercoagulable states, sickle cell disease and undetermined causes ~~(Kernan, 2014)~~.[43] TIAs in contrast, "are a brief episode of neurological dysfunction caused by focal brain or retinal ischemia, with clinical symptoms typically lasting less than one hour, and without evidence of acute infarction on imaging ~~(Easton, 2009)~~."[44] On average, the annual risk of future ischemic stroke after a TIA or initial ischemic stroke is 3–4%, with an incidence as high as 11% over the next 7 days and 24–29% over the following 5 years. This has significantly decreased in the last half century due to advances in secondary prevention ~~(Hong, 2011)~~.[45]

When revascularization therapy is not indicated or available in patients with an ischemic stroke or TIA, the focus of the work-up is on secondary prevention. This includes noninvasive vascular imaging to identify the underlying etiology, assess immediate complications and risk of future stroke. The majority of stroke evaluations take place in the inpatient setting. Admitting TIA patients is reasonable if they present within 72 hours and have an ABCD(2) score >or=3, indicating high risk of early recurrence, or the evaluation cannot be rapidly completed on an outpatient basis ~~(Easton, 2009)~~.[44] Minimally, both stroke and TIA should have an evaluation for high-risk modifiable factors, such as carotid stenosis atrial fibrillation, as the cause of ischemic symptoms ~~(Kernan, 2014)~~.[43] Diagnostic recommendations include neuroimaging evaluation as soon as possible, preferably with magnetic resonance imaging, including DWI; noninvasive imaging of the extracranial vessels should be performed, and noninvasive imaging of intracranial vessels is reasonable ~~(Wintermark, 2013)~~.[32]

Patients with a history of stroke and recent work-up with new signs or symptoms indicating progression or complications of the initial CVA should have repeat brain imaging as an initial study. Patients with remote or silent strokes discovered on imaging should be evaluated for high-risk modifiable risk factors based on the location and type of the presumed etiology of the brain injury.

POLICY HISTORY

Date	Summary
March 2022	~~Updated and reformatted references~~ ~~*New combo statement as above*~~ **Updated background on MRA Vs CTA** **Clarified** • **Pulsatile tinnitus to identify *a suspected arterial* vascular etiology** • ~~–~~**Large vessel vasculitis with suspected extracranial involvement**~~[20 23]~~

	Added: • **For further evaluation of a congenital vascular malformation of the head and neck** • **Pulsatile tinnitus in new combo section (MRI Brain with IAC/MRA Head/MRA Neck)** • **New Combo statement**
May 2021	Updated references Added • Loeys-Dietz syndrome to aneurysm screening section • Known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as dizziness, vertigo, headaches, diplopia, blindness, vomiting, ataxia and weakness in both sides of the body, or abnormal speech – which was before only in the combo section • Note: Ultrasound (US) may be used to identify a mass overlying or next to an artery in initial work up of a pulsatile mass. • For evaluation of pulsatile tinnitus (subjective or objective) for vascular etiology - which was before only in the combo section • Pre-operative evaluation for a planned surgery or procedure • Approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent vascular and intracranial pathology (Lawson, 2000). Clarified • Giant cell arteritis *with suspected extracranial involvement* Deleted*:* • After US (for pulsatile neck mass)
May 2020	Clarified: • Recent **ischemic** stroke or transient ischemic attack (also in combo section) • Pulsatile mass on exam after ultrasound (US) • Takayasu arteritis based on findings in other blood vessels on previous imaging • Giant cell arteritis • Known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as dizziness, vertigo, headaches, diplopia, blindness, vomiting, ataxia and weakness in both sides of the body, or abnormal speech • Suspected carotid or vertebral artery dissection; due to trauma or spontaneous due to weakness of vessel wall leading to dissection (combo section) Deleted:

	• Ehlers-Danlos syndrome and neurofibromatosis in screening for aneurysm Added: • Spontaneous coronary arteries dissection (SCAD) in screening for aneurysm • Suspected carotid or vertebral artery dissection; due to trauma or spontaneous due to weakness of vessel wall leading to dissection • Horner's syndrome (miosis, ptosis, and anhidrosis) • Known extracranial vascular disease that needs follow-up or further evaluation
April 2019	• Suspected or known disease: Added "Giant cell arteritis" and "Subclavian steal syndrome when ultrasound is positive or indeterminate or for planning interventions • "Known or suspected tumor/*pulsatile* mass": Added 'pulsatile'; • Neck MRA/Brain MRA: Added Denver screening criteria to assess for cerebrovascular injury • Added background information describing MRA and CTA as complimentary information to MRI or CT

REFERENCES

Abdel Razek AA, Alvarez H, Bagg S, et al. Imaging spectrum of CNS vasculitis. *Radiographics*. 2014 Jul-Aug; 34(4):873-94).

Al-Rawaq KJ, Al-Naqqash MA, Al-Saad RK, et al. Carotid body tumor: A review of the literature and two cases reports in Baghdad radiation oncology center, Medical City, Bagdhad, Iraq. *J Tumor*. 2018 May; 6(1):516-19.

Ansari S, Carmody T, Erickson K, et al. ACR-ASNR-SNIS-SPR Practice Parameter for the performance of cervicocerebral magnetic resonance angiography (MRA). American College of Radiology Practice Parameters and Technical Standards. Revised 2020. Accessed June 25, 2021. https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CervicoCerebralMRA.pdf

Aulino JM, Kirsch CFE, Burns J, et al. ACR Appropriateness Criteria® Neck Mass-Adenopathy. *Journal of the American College of Radiology*. 2019;16(5):S150-S160. doi:10.1016/j.jacr.2019.02.025

Brott TG, Halperin JL, Abbara S, et al. ASA / ACCF / AHA / AANN / AANS / ACR / ASNR / CNS / SAIP / SCAI / SIR / SNIS / SVM / SVS guideline on the management of patients with extracranial carotid and vertebral artery disease: Executive summary. *Circulation*. 2011; 124:489-532. http://www.ncbi.nlm.nih.gov/pubmed/21282493.

Chaturvedi S, Bruno A, Feasby T, et al. Carotid endarterectomy--an evidence-based review: Report of the therapeutics and technology assessment subcommittee of the American Academy of Neurology. *Neurology*. 2005;65(6):794-801. doi:10.1212/01.wnl.0000176036.07558.82

DaCosta M, Surowiec SM. Carotid Endarterectomy. *StatPearls*. Treasure Island, FL: StatPearls Publishing; 2019.

Easton JD, Saver JL, Albers GW, et al. Definition and evaluation of transient ischemic attack: A scientific statement for healthcare professionals from the American Heart Association/American Stroke Association Stroke Council; Council on Cardiovascular Surgery and Anesthesia; Council on Cardiovascular Radiology and Intervention; Council on Cardiovascular Nursing; and the Interdisciplinary Council on Peripheral Vascular Disease. *Stroke*. 2009; *40*:2276–2293.

Franz RW, Willette PA, Wood MJ, et al. A systematic review and meta-analysis of diagnostic screening criteria for blunt cerebrovascular injuries. *J Am Coll Surg*. March 2012; 214(3):313-27.

Guneyli S, Ceylan N, Bayraktaroglu S, et al. Imaging findings of vascular lesions in the heard and neck. *Diagn Interv Radiol*. 2014 Sep-Oct; 20(5):432-7.

Halbach C, McClelland CM, Chen J, et al. Use of noninvasive imaging in giant cell arteritis. *Asia Pac J Ophthalmol (Phila)*. 2018;7(4):260-264. doi:10.22608/APO.2018133

Hayes SN, Kim ESH, Saw J, et al. Spontaneous coronary artery dissection: Current state of the science: A scientific statement from the American Heart Association. *Circulation*. 2018 May 8; 137(19):e523-e557. doi:10.1161/CIR.0000000000000564.

Hitchcock E, Gibson WT. A review of the genetics of intracranial berry aneurysms and implications for genetic counseling. *J Genet Couns*. 2017;26(1):21–31. doi:10.1007/s10897-016-0029-8.

Hong KS, Yegiaian S, Lee M, et al. Declining stroke and vascular event recurrence rates in secondary prevention trials over the past 50 years and consequences for current trial design. *Circulation*. 2011 May 17; 123(19):2111-9. doi: 10.1161/CIRCULATIONAHA.109.934786.

Jadhav AP, Jovin TG. (2012). Vascular imaging of the head and neck. *Semin Neurol.* 2012; 32(04):401-410. doi: 10.1055/s-0032-1331811.

Kernan WN, Ovbiagele B, Black HR, et al. Guidelines for the prevention of stroke in patients with stroke and transient ischemic attack: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. 2014 Jul; 45(7):2160-236. doi: 10.1161/STR.0000000000000024.

Khan A, Dasgupta B. Imaging in giant cell arteritis. *Curr Rheumatol Rep*. 2015;17(8):52. doi:10.1007/s11926-015-0527-y

Kim JD, Hashemi N, Gelman R, et al. Neuroimaging in ophthalmology. *Saudi J Ophthalmol*. 2012; 26(4):401–407. doi:10.1016/j.sjopt.2012.07.001.

Koster MJ, Matteson EL, Warrington KJ. Large-vessel giant cell arteritis: Diagnosis, monitoring, and management. *Rheumatol*. 2018; 57(suppl2):ii32-42.

Lawson GR. Controversy: Sedation of children for magnetic resonance imaging. *Arch Dis Child*. 2000;82(2):150-153. doi:10.1136/adc.82.2.150

Liang T, Tso DK, Chiu RY, et al. Imaging of blunt vascular neck injuries: A review of screening and imaging modalities. *AJR Am J Roentgenol*. 2013 Oct; 201(4):884-92.

Lima-Neto AC, Bittar R, Gattas GS, et al. Pathophysiology and diagnosis of vertebrobasilar insuffiency: A review of the literature. *Int Arch Otorhinolaryngol*. 2017 July; 21(3):302-07.

Macaya F, Moreu M, Ruiz-Pizarro V, et al. Screening of extra-coronary arteriopathy with magnetic resonance angiography in patients with spontaneous coronary artery dissection: A single-centre experience. *Cardiovasc Diagn Ther*. 2019 Jun; 9(3):229-238. doi:10.21037/cdt.2019.04.09.

MacCarrick G, Black JH, Bowdin S, et al. Loeys–Dietz syndrome: A primer for diagnosis and management. *Genet Med*. 2014;16(8):576-587. doi:10.1038/gim.2014.11

Marquardt L, Geraghty OC, Mehta Z, et al. Low risk of ipsilateral stroke in patients with asymptomatic carotid stenosis on best medical treatment: A prospective, population-based study. *Stroke*. 2010; 41(1):e11.

Mundinger GS, Dorafshar AH, Gilson MM, et al. Blunt-mechanism facial fracture patterns associated with internal carotid artery injuries: recommendations for additional screening criteria based on analysis of 4,398 patients. *J Oral Maxillofac Surg*. December 2013; 71(12):2092-2100.

Nash M, Rafay MF. Craniocervical arterial dissection in children: Pathophysiology and management. *Pediatr Neurol*. 2019 Jun; 95:9-18. doi:10.1016/j.pediatrneurol.2019.01.020.

Nguyen RP, Shah LM, Quigley EP, et al. Carotid body detection on CT angiography. *AJNR Am J Neuroradiol*. 2011 Jun; 32(6):1096-99.

Pegge SAH, Steens SCA, Kunst HPM, et al. Pulsatile tinnitus: Differential diagnosis and radiological work-up. *Curr Radiol Rep*. 2017; 5(1):5.

Potter BJ, Pinto DS. Subclavian steal syndrome. *Circulation*. 2014 Jun; 129(22):2320-3.

Rerkasem K, Rothwell PM. Carotid endarterectomy for symptomatic carotid stenosis. *Cochrane Database Syst Rev*. 2011.

Robertson RL, Palasis S, Rivkin, MJ, et al. ACR Appropriateness Criteria® Cerebrovascular Disease-Child. *J Am Coll Radiol*. 2020;17(5S):S36-S54. doi:10.1016/j.jacr.2020.01.036

Sacco RL, Kasner SE, Broderick JP, et al. An updated definition of stroke for the 21st century: A statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. 2013; *44*:2064–2089.

Salmela MB, Mortazavi S, Jagadeesan, BD, et al. ACR Appropriateness Criteria® Cerebrovascular Disease. *J Am Coll Radiol*. 2017;14(5S):S34-S61. doi:10.1016/j.jacr.2017.01.05

Sanelli PC, Sykesa JB, Ford AL, et al. Imaging and treatment of patients with acute stroke: An evidence-based review. *AJNR Am J Neuroradiol*. 2014; 35:1045-1051.

Searls DE, Pazdera L, Korbel E, et al. Symptoms and signs of posterior circulation ischemia in the new England medical center posterior circulation registry. *Arch Neurol*. 2012; 69(3):346.

Simon LV, Mohseni M. Vertebral Artery Injury. *StatPearls*.Treasure Island, FL: StatPearls Publishing; 2019. https://www.ncbi.nlm.nih.gov/books/NBK470363/.

Shakir HJ, Davies JM, Shallwani H, et al. Carotid and vertebral dissection imaging. *Curr Pain Headache Rep*. 2016 Dec; 20(12):68.

Wintermark M, Sanelli PC, Albers GW, et al. Imaging recommendations for acute stroke and transient ischemic attack patients: A joint statement by the American Society of Neuroradiology, the American College of Radiology, and the Society of NeuroInterventional Surgery. *AJNR Am J Neuroradiol*. 2013 Nov-Dec; 34(11):E117-27. doi: 10.3174/ajnr.A3690.

Yang CW, Carr JC, Futterer SF, et al. Contrast-enhanced MR angiography of the carotid and vertebrobasilar circulations. *AJNR Am J Neuroradiol*. 2005;26(8):2095-2101.

Zhu FP, Luo S, Wang ZJ, et al. Takayasu arteritis: Imaging spectrum at multidetector CT angiography. *Br J Radiol*. 2012 Dec; 85(1020):e1282-1292.

Reviewed / Approved by NIA Clinical Guideline Committee

~~**GENERAL INFORMATION**~~

~~It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. If applicable: All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted.~~

1. Robertson RL, Palasis S, Rivkin MJ, et al. ACR Appropriateness Criteria® Cerebrovascular Disease-Child. *J Am Coll Radiol*. May 2020;17(5s):S36-s54. doi:10.1016/j.jacr.2020.01.036
2. Salmela MB, Mortazavi S, Jagadeesan BD, et al. ACR Appropriateness Criteria(®) Cerebrovascular Disease. *J Am Coll Radiol*. May 2017;14(5s):S34-s61. doi:10.1016/j.jacr.2017.01.051
3. Sanelli PC, Sykes JB, Ford AL, Lee JM, Vo KD, Hallam DK. Imaging and treatment of patients with acute stroke: an evidence-based review. *AJNR Am J Neuroradiol*. Jun 2014;35(6):1045-51. doi:10.3174/ajnr.A3518
4. Lima Neto AC, Bittar R, Gattas GS, et al. Pathophysiology and Diagnosis of Vertebrobasilar Insufficiency: A Review of the Literature. *Int Arch Otorhinolaryngol*. Jul 2017;21(3):302-307. doi:10.1055/s-0036-1593448
5. Searls DE, Pazdera L, Korbel E, Vysata O, Caplan LR. Symptoms and signs of posterior circulation ischemia in the new England medical center posterior circulation registry. *Arch Neurol*. Mar 2012;69(3):346-51. doi:10.1001/archneurol.2011.2083
6. Yang CW, Carr JC, Futterer SF, et al. Contrast-enhanced MR angiography of the carotid and vertebrobasilar circulations. *AJNR Am J Neuroradiol*. Sep 2005;26(8):2095-101.
7. Brott TG, Halperin JL, Abbara S, et al. 2011 ASA/ACCF/AHA/AANN/AANS/ACR/ASNR/CNS/SAIP/SCAI/SIR/SNIS/SVM/SVS guideline on the management of patients with extracranial carotid and vertebral artery disease: executive summary. A report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, and the American Stroke Association, American

Association of Neuroscience Nurses, American Association of Neurological Surgeons, American College of Radiology, American Society of Neuroradiology, Congress of Neurological Surgeons, Society of Atherosclerosis Imaging and Prevention, Society for Cardiovascular Angiography and Interventions, Society of Interventional Radiology, Society of NeuroInterventional Surgery, Society for Vascular Medicine, and Society for Vascular Surgery. *Circulation*. Jul 26 2011;124(4):489-532. doi:10.1161/CIR.0b013e31820d8d78
8. DaCosta M, Tadi P, Surowiec SM. Carotid Endarterectomy. StatPearls Publishing Updated September 29, 2021. Accessed November 4, 2021. https://www.ncbi.nlm.nih.gov/books/NBK470582/
9. Marquardt L, Geraghty OC, Mehta Z, Rothwell PM. Low risk of ipsilateral stroke in patients with asymptomatic carotid stenosis on best medical treatment: a prospective, population-based study. *Stroke*. Jan 2010;41(1):e11-7. doi:10.1161/strokeaha.109.561837
10. Rerkasem K, Rothwell PM. Carotid endarterectomy for symptomatic carotid stenosis. *Cochrane Database Syst Rev*. Apr 13 2011;(4):Cd001081. doi:10.1002/14651858.CD001081.pub2
11. Chaturvedi S, Bruno A, Feasby T, et al. Carotid endarterectomy--an evidence-based review: report of the Therapeutics and Technology Assessment Subcommittee of the American Academy of Neurology. *Neurology*. Sep 27 2005;65(6):794-801. doi:10.1212/01.wnl.0000176036.07558.82
12. Hayes SN, Kim ESH, Saw J, et al. Spontaneous Coronary Artery Dissection: Current State of the Science: A Scientific Statement From the American Heart Association. *Circulation*. May 8 2018;137(19):e523-e557. doi:10.1161/cir.0000000000000564
13. Hitchcock E, Gibson WT. A Review of the Genetics of Intracranial Berry Aneurysms and Implications for Genetic Counseling. *J Genet Couns*. Feb 2017;26(1):21-31. doi:10.1007/s10897-016-0029-8
14. Macaya F, Moreu M, Ruiz-Pizarro V, et al. Screening of extra-coronary arteriopathy with magnetic resonance angiography in patients with spontaneous coronary artery dissection: a single-centre experience. *Cardiovasc Diagn Ther*. Jun 2019;9(3):229-238. doi:10.21037/cdt.2019.04.09
15. MacCarrick G, Black JH, 3rd, Bowdin S, et al. Loeys-Dietz syndrome: a primer for diagnosis and management. *Genet Med*. Aug 2014;16(8):576-87. doi:10.1038/gim.2014.11
16. Aulino JM, Kirsch CFE, Burns J, et al. ACR Appropriateness Criteria(®) Neck Mass-Adenopathy. *J Am Coll Radiol*. May 2019;16(5s):S150-s160. doi:10.1016/j.jacr.2019.02.025
17. Al-Rawaq KJ, Al-Naqqash MA, Al-Shewered AS, Al-Awadi AF. Carotid Body Tumour a Challenging Management: Rare Case Report in Baghdad Radiation Oncology Center, Medical City, Baghdad, Iraq. *JCTI*. 2018;7(3):1-6.
18. Nguyen RP, Shah LM, Quigley EP, Harnsberger HR, Wiggins RH. Carotid body detection on CT angiography. *AJNR Am J Neuroradiol*. Jun-Jul 2011;32(6):1096-9. doi:10.3174/ajnr.A2429
19. Abdel Razek AA, Alvarez H, Bagg S, Refaat S, Castillo M. Imaging spectrum of CNS vasculitis. *Radiographics*. Jul-Aug 2014;34(4):873-94. doi:10.1148/rg.344135028
20. Halbach C, McClelland CM, Chen J, Li S, Lee MS. Use of Noninvasive Imaging in Giant Cell Arteritis. *Asia Pac J Ophthalmol (Phila)*. Jul-Aug 2018;7(4):260-264. doi:10.22608/apo.2018133
21. Khan A, Dasgupta B. Imaging in Giant Cell Arteritis. *Curr Rheumatol Rep*. Aug 2015;17(8):52. doi:10.1007/s11926-015-0527-y

22. Koster MJ, Matteson EL, Warrington KJ. Large-vessel giant cell arteritis: diagnosis, monitoring and management. *Rheumatology (Oxford)*. Feb 1 2018;57(suppl_2):ii32-ii42. doi:10.1093/rheumatology/kex424
23. Aghayev A, Steigner ML, Azene EM, et al. ACR Appropriateness Criteria® Noncerebral Vasculitis. *J Am Coll Radiol*. Nov 2021;18(11s):S380-s393. doi:10.1016/j.jacr.2021.08.005
24. Potter BJ, Pinto DS. Subclavian steal syndrome. *Circulation*. Jun 3 2014;129(22):2320-3. doi:10.1161/circulationaha.113.006653
25. Franz RW, Willette PA, Wood MJ, Wright ML, Hartman JF. A systematic review and meta-analysis of diagnostic screening criteria for blunt cerebrovascular injuries. *J Am Coll Surg*. Mar 2012;214(3):313-27. doi:10.1016/j.jamcollsurg.2011.11.012
26. Shakir HJ, Davies JM, Shallwani H, Siddiqui AH, Levy EI. Carotid and Vertebral Dissection Imaging. *Curr Pain Headache Rep*. Dec 2016;20(12):68. doi:10.1007/s11916-016-0593-5
27. Kim JD, Hashemi N, Gelman R, Lee AG. Neuroimaging in ophthalmology. *Saudi J Ophthalmol*. Oct 2012;26(4):401-7. doi:10.1016/j.sjopt.2012.07.001
28. Pegge SAH, Steens SCA, Kunst HPM, Meijer FJA. Pulsatile Tinnitus: Differential Diagnosis and Radiological Work-Up. *Curr Radiol Rep*. 2017;5(1):5. doi:10.1007/s40134-017-0199-7
29. Brahmbhatt AN, Skalski KA, Bhatt AA. Vascular lesions of the head and neck: an update on classification and imaging review. *Insights Imaging*. Feb 7 2020;11(1):19. doi:10.1186/s13244-019-0818-3
30. Nair SC. Vascular Anomalies of the Head and Neck Region. *J Maxillofac Oral Surg*. Mar 2018;17(1):1-12. doi:10.1007/s12663-017-1063-2
31. Flors L, Leiva-Salinas C, Maged IM, et al. MR imaging of soft-tissue vascular malformations: diagnosis, classification, and therapy follow-up. *Radiographics*. Sep-Oct 2011;31(5):1321-40; discussion 1340-1. doi:10.1148/rg.315105213
32. Wintermark M, Sanelli PC, Albers GW, et al. Imaging recommendations for acute stroke and transient ischemic attack patients: A joint statement by the American Society of Neuroradiology, the American College of Radiology, and the Society of NeuroInterventional Surgery. *AJNR Am J Neuroradiol*. Nov-Dec 2013;34(11):E117-27. doi:10.3174/ajnr.A3690
33. Lawson GR. Controversy: Sedation of children for magnetic resonance imaging. *Arch Dis Child*. Feb 2000;82(2):150-3. doi:10.1136/adc.82.2.150
34. Yew KS. Diagnostic approach to patients with tinnitus. *Am Fam Physician*. Jan 15 2014;89(2):106-13.
35. American College of Radiology (ACR), American Society of Neuroradiology (ASNR), Society of NeuroInterventional Surgery (SNIS), Society for Pediatric Radiology (SPR). ACR-ASNR-SNIS-SPR practice parameter for the performance of cervicocerebral magnetic resonance angiography (MRA). American College of Radiology. Updated 2020. Accessed January 7, 2022. https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CervicoCerebralMRA.pdf
36. American College of Radiology. ACR Appropriateness Criteria® Cerebrovascular Diseases-Aneurysm, Vascular Malformation, and Subarachnoid Hemorrhage. American College of Radiology (ACR). Updated 2021. Accessed December 21, 2021. https://acsearch.acr.org/docs/3149013/Narrative/
37. American College of Radiology. ACR Appropriateness Criteria®Cerebrovascular Disease. American College of Radiology (ACR). Updated 2016. Accessed March 14, 2022. https://acsearch.acr.org/docs/69478/Narrative/

38. Liang T, Tso DK, Chiu RY, Nicolaou S. Imaging of blunt vascular neck injuries: a review of screening and imaging modalities. *AJR Am J Roentgenol*. Oct 2013;201(4):884-92. doi:10.2214/ajr.12.9664
39. Mundinger GS, Dorafshar AH, Gilson MM, Mithani SK, Manson PN, Rodriguez ED. Blunt-mechanism facial fracture patterns associated with internal carotid artery injuries: recommendations for additional screening criteria based on analysis of 4,398 patients. *J Oral Maxillofac Surg*. Dec 2013;71(12):2092-100. doi:10.1016/j.joms.2013.07.005
40. Simon LV, Nassar AK, Mohseni M. Vertebral Artery Injury. StatPearls Publishing Updated July 21, 2021. Accessed November 4, 2021. https://www.ncbi.nlm.nih.gov/books/NBK470363/
41. Nash M, Rafay MF. Craniocervical Arterial Dissection in Children: Pathophysiology and Management. *Pediatr Neurol*. Jun 2019;95:9-18. doi:10.1016/j.pediatrneurol.2019.01.020
42. Sacco RL, Kasner SE, Broderick JP, et al. An updated definition of stroke for the 21st century: a statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. Jul 2013;44(7):2064-89. doi:10.1161/STR.0b013e318296aeca
43. Kernan WN, Ovbiagele B, Black HR, et al. Guidelines for the prevention of stroke in patients with stroke and transient ischemic attack: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. Jul 2014;45(7):2160-236. doi:10.1161/str.0000000000000024
44. Easton JD, Saver JL, Albers GW, et al. Definition and evaluation of transient ischemic attack: a scientific statement for healthcare professionals from the American Heart Association/American Stroke Association Stroke Council; Council on Cardiovascular Surgery and Anesthesia; Council on Cardiovascular Radiology and Intervention; Council on Cardiovascular Nursing; and the Interdisciplinary Council on Peripheral Vascular Disease. The American Academy of Neurology affirms the value of this statement as an educational tool for neurologists. *Stroke*. Jun 2009;40(6):2276-93. doi:10.1161/strokeaha.108.192218
45. Hong KS, Yegiaian S, Lee M, Lee J, Saver JL. Declining stroke and vascular event recurrence rates in secondary prevention trials over the past 50 years and consequences for current trial design. *Circulation*. May 17 2011;123(19):2111-9. doi:10.1161/circulationaha.109.934786

ADDITIONAL RESOURCES

1. Güneyli S, Ceylan N, Bayraktaroğlu S, Acar T, Savaş R. Imaging findings of vascular lesions in the head and neck. *Diagn Interv Radiol*. Sep-Oct 2014;20(5):432-7. doi:10.5152/dir.2014.14004
2. Jadhav AP, Jovin TG. Vascular imaging of the head and neck. *Semin Neurol*. Sep 2012;32(4):401-10. doi:10.1055/s-0032-1331811

Reviewed / Approved by NIA Clinical Guideline Committee

GENERAL INFORMATION

It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. If applicable: All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted.